ULTRAFINE COPPER ALLOY WIRE, STRANDED COPPER ALLOY WIRE CONDUCTOR, EXTRAFINE COAXIAL CABLE, AND PROCESS FOR PRODUCING ULTRAFINE COPPER ALLOY WIRE

FIELD OF THE INVENTION

The invention relates to an ultrafine copper alloy wire, a stranded copper alloy wire conductor, and an extrafine coaxial cable each comprising a copper alloy wire with a diameter of not more than 0.08 mm, and a process for producing the ultrafine copper alloy wire, and more particularly to an ultrafine copper alloy wire, a stranded copper alloy wire conductor, and an extrafine coaxial cable possessing excellent tensile strength, wire drawability, and bending properties, and a process for producing the ultrafine copper alloy wire.

BACKGROUND OF THE INVENTION

A reduction in size of electronic equipment, IC testers, and medical ultrasound system has led to a demand for a reduction in diameter of electric wires for these types of equipment. In particular, in the case of electric wires for medical ultrasound system, there is a demand for cables which have an increased number of wire cores while maintaining the outer diameter of conventional cables. Conductors currently in use in practical applications are mainly 40AWG (7/0.03). Among them, those which have been extensively used in the art are copper alloy wires comprising an oxygen-free copper (OFC) having an impurity content of about 10 ppm as a base metal and a very small amount of tin added to the base metal.

Problems involved in the drawing of a wire rod through dicing are wire breaking attributable to foreign materials and wire breaking attributable to ductile fracture.

Detailed analysis of samples, which have been broken due to the presence of foreign materials, has revealed that the cause of the inclusion of foreign materials is classified roughly into two routes. One of them is foreign materials externally included during wire drawing. The other route is inclusions contained in copper as a material or additive elements or peeled pieces produced by the separation of refractories, such as SiC, SiO_2, and ZrO_2, which are components of crucibles and molds, during melting and casting. Among these foreign materials, the inclusion of the former type of foreign materials can be reduced by performing the step of wire drawing in a clean environment. On the other hand, improving the quality of the base material is necessary for reducing the amount of the latter type of foreign materials. For the ductile failure, it is known that this failure is closely related to the level of working. When the level of working is large, the deformation resistance is large and the plastic deformation is less likely to occur. Therefore, ductile failure is likely to occur. However, when the level of working does not reach the working limit, the higher the strength of the material, the lower the susceptibility to the ductile failure. Therefore, materials having higher strength are desired. Thus, in the production of ultrafine wires, very careful attention should be paid so as to avoid the inclusion of foreign materials in each of the steps in the production

process.

An example of a conventional extrafine conductor, which has attempted to solve the problem of wire breaking attributable to foreign materials, is described in Japanese Patent Laid-Open No. 293365/1999.

This extrafine conductor comprises 1 to 4.5% by weight of silver with the balance consisting of copper and unavoidable impurities, and the diameter of foreign materials contained in the extrafine conductor has been brought to a predetermined value or less relative to the diameter of the extrafine conductor. This can realize the provision of extrafine conductors possessing tensile strength, wire drawability, and windability which are high enough to reduce wire breaking during wire drawing and winding. For example, when the diameter of the extrafine conductor is 20 μm, bringing the diameter of the foreign materials to not more than 12 μm can bring about good results.

In the conventional extrafine conductor, however, since the foreign material to be excluded is specified by the diameter of the foreign material, there is a problem that, when the amount of foreign materials having a diameter of not more than the specified diameter is large, wire breaking is likely to occur during wire drawing and, in addition, the bending properties are poor.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide an ultrafine copper alloy wire, a stranded copper alloy wire

conductor, and an extrafine coaxial cable possessing excellent tensile strength, wire drawability, and bending properties, and a process for producing the ultrafine copper alloy wire.

In order to attain the above object, according to the first feature of the invention, an ultrafine copper alloy wire with a diameter of not more than 0.08 mm is constituted by a copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass.

The wire diameter should be not more than 0.08 mm. This is because wires having a diameter exceeding 0.08 mm can be stably produced even when conventional oxygen-free copper (OFC) is used as the base material. The use of high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass can minimize the content of the foreign material, causative of wire breaking, in the base material. The addition of silver to the high-purity copper can improve the tensile strength without a significant lowering in electrical conductivity as compared with the addition of tin, and thus can reduce the ductile failure. Bringing the purity of silver to not less than 99.99% by mass can minimize the contamination of copper as the matrix. The content of silver is limited to 1.0 to 5.0% by mass. When the silver content is less than 1.0% by mass, the amount of eutectic crystal phase crystallized is very small. Therefore, in this case, the effect of improving the strength is poor. When the silver content exceeds 5.0% by mass, work hardening is significant. In this case, cold-drawing

cannot be successfully carried out without providing the step of heat treatment in the course of the drawing of ultrafine conductors having a diameter of not more than 0.02 mm.

In order to attain the above object, according to the second feature of the invention, an ultrafine copper alloy wire with a diameter of not more than 0.08 mm is constituted by a copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.5% by mass of magnesium having a purity of not less than 99.9% by mass.

In addition to silver, magnesium having a purity of not less than 99.9% by mass may be added in an amount of 0.01 to 0.5% by mass. The reason why magnesium is added is that, since silver is expensive, a part of silver is replaced with magnesium as an additive element which does not significantly lower the electric conductivity to lower the silver content. The purity of magnesium is limited to not less than 99.9% by mass from the viewpoint of minimizing the contamination of copper as the matrix. The content of magnesium is limited to 0.01 to 0.5% by mass. When the magnesium content is less than 0.01% by mass, no satisfactory effect can be attained by the addition of magnesium. On the other hand, when the magnesium content exceeds 0.5% by mass, work hardening is significant, and, in this case, cold-drawing cannot be successfully carried out without providing the step of heat treatment in the course of the wire drawing of ultrafine conductors.

In order to attain the above object, according to the third feature of the invention, an ultrafine copper alloy wire with a diameter of not more than 0.08 mm is constituted by a copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.3% by mass of indium having a purity of not less than 99.99% by mass.

In addition to silver, indium having a purity of not less than 99.99% by mass may be added in an amount of 0.01 to 0.3% by mass. The reason why indium is added is that, since silver is expensive, a part of silver is replaced with indium as an additive element which does not significantly lower the electric conductivity to lower the silver content. The purity of indium is limited to not less than 99.99% by mass from the viewpoint of minimizing the contamination of copper as the matrix. The content of indium is limited to 0.01 to 0.3% by mass. When the indium content is less than 0.01% by mass, no satisfactory effect can be attained by the addition of indium. On the other hand, when the indium content exceeds 0.3% by mass, work hardening is significant, and, in this case, cold-drawing cannot be successfully carried out without providing the step of heat treatment in the course of the wire drawing of ultrafine conductors.

The copper alloy wire may have thereon a tin plating, a silver plating, a nickel plating, a tin-lead solder plating, a tin-silver plating, a tin-copper plating, a tin-silver-copper

plating, or a tin-silver-copper-bismuth plating. The adoption of this construction can realize good corrosion resistance and terminal connection when the alloy wire is used as electric wires for equipment.

Further, in order to attain the above object, according to the fourth feature of the invention, a stranded copper alloy wire conductor comprises a plurality of copper alloy wires with a diameter of not more than 0.08 mm stranded together, said copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass.

Stranding a plurality of copper alloy wires together can reduce bending strain when the outer diameter of the conductor is identical. Therefore, the bending fatigue lifetime can be prolonged in applications which is used under repeatedly bent condition.

In order to attain the above object, according to the fifth feature of the invention, a stranded copper alloy wire conductor comprises a plurality of copper alloy wires with a diameter of not more than 0.08 mm stranded together, said copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.5% by mass of magnesium having a purity of not less than 99.9% by mass.

Further, in order to attain the above object, according

to the sixth feature of the invention, a stranded copper alloy wire conductor comprises a plurality of copper alloy wires with a diameter of not more than 0.08 mm stranded together, said copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.3% by mass of indium having a purity of not less than 99.99% by mass.

Further, in order to attain the above object, according to the seventh feature of the invention, an extrafine coaxial cable comprises a copper alloy wire with a diameter of not more than 0.08 mm provided for constituting an inner conductor or an outer conductor, said copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass.

Further, in order to attain the above object, according to the eighth feature of the invention, an extrafine coaxial cable comprises a copper alloy wire with a diameter of not more than 0.08 mm provided for constituting an inner conductor or an outer conductor, said copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.5% by mass of magnesium having a purity of not less than 99.9% by mass.

Further, in order to attain the above object, according to the ninth feature of the invention, an extrafine coaxial cable comprises a copper alloy wire with a diameter of not more than 0.08 mm provided for constituting an inner conductor or an outer conductor, said copper alloy wire comprising high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.3% by mass of indium having a purity of not less than 99.99% by mass.

Further, in order to attain the above object, according to the tenth feature of the invention, a process for producing an ultrafine copper alloy wire, comprises the steps of: melting a high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass in a carbon crucible installed in a vacuum; replacing an atmosphere surrounding the melted copper by an argon gas atmosphere and adding 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass to said copper; casting said copper with silver added thereto in a carbon mold into a wire rod; and drawing said wire rod to a diameter of not more than 0.08 mm.

In this production process, the crucible and mold used are limited respectively to a carbon crucible and a carbon mold. The reason for this is that a major part of foreign materials included during melting and casting is accounted for, for example, by SiC, SiO_2, and ZrO_2, which are components of ceramics and cement used in crucibles or molds employed in melting and/or molds used in casting and are separated from the

crucibles and included in the melt.

In order to attain the above object, according to the eleventh feature of the invention, a process for producing an ultrafine copper alloy wire, comprises the steps of: melting a high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass in a carbon crucible installed in a vacuum; replacing an atmosphere surrounding the melted copper by an argon gas atmosphere and adding, to said copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.5% by mass of magnesium having a purity of not less than 99.9% by mass; casting said copper with silver and magnesium added thereto in a carbon mold into a wire rod; and drawing said wire rod to a diameter of not more than 0.08 mm.

Further, in order to attain the above object, according to the twelfth feature of the invention, a process for producing an ultrafine copper alloy wire, comprises the steps of: melting a high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass in a carbon crucible installed in a vacuum; replacing an atmosphere surrounding the melted copper by an argon gas atmosphere and adding, to said copper, 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass and 0.01 to 0.3% by mass of indium having a purity of not less than 99.99% by mass; casting said copper with silver and indium added thereto in a carbon mold into a wire rod; and drawing said wire rod to a diameter of not more than 0.08 mm.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be explained in more detail in conjunction with the appended drawings, wherein:

Fig. 1 is a cross-sectional view of an extrafine coaxial cable according to the first preferred embodiment of the invention; and

Fig. 2 is a cross-sectional view of an extrafine coaxial cable according to the second preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention will be described in conjunction with the accompanying drawings. Fig. 1 shows an extrafine coaxial cable according to the first preferred embodiment of the invention. This extrafine coaxial cable comprises: an inner conductor 1 of a conductor size 44AWG composed of a plurality of extrafine copper alloy wires stranded together (seven ultra fine copper alloy wires with a diameter of 0.02 mm stranded together); an insulation 2 which is provided around the inner conductor 1 to insulate the inner conductor 1; an outer conductor 3 provided around the insulation 2, for removing noise, the outer conductor 3 comprising ultrafine copper alloy wires with a diameter of 0.02 mm; and a jacket 4 provided around the outer conductor 3. The insulation 2 may be formed of, for example, a solid fluororesin, more specifically FEP, PFA, or ETFE. In the insulation 2, for example, the outer diameter is 0.115 mm, and the wall thickness is 0.06 mm. The jacket 4 is formed of, for example, PET. In

this jacket 4, for example, the outer diameter is 0.215 mm, and the wall thickness is 0.02 mm.

The material for the ultrafine copper alloy wire used in the inner conductor 1 and the outer conductor 3 is one comprising high-purified copper, plated with a silver plating, having a total unavoidable impurity content of not more than 1 ppm by mass and, added to the high-purity copper, an element, such as silver, magnesium, or indium, having a purity of not less than 99.99% by mass, and examples thereof include Cu - 1.0 to 5.0 mass% Ag, Cu - 1.0 to 5.0 mass% Ag - 0.01 to 0.05 mass% Mg, and Cu - 0.01 to 0.3 mass% In.

This ultrafine copper alloy wire may be produced, for example, by the following process. Here the production of an alloy wire of Cu - 1.0 to 5.0 mass% Ag will be described. At the outset, high-purity copper having a total unavoidable impurity content of not more than 1 ppm by mass is pickled to remove foreign materials adhered onto the surface of the high-purity copper. The pickled copper is then placed in a carbon crucible, and the pickled copper is then vacuum melted in a small continuous casting system. Upon complete melting of copper, the atmosphere in the chamber is replaced by argon gas, and 1.0 to 5.0% by mass of silver having a purity of not less than 99.99% by mass is added to the melt. After silver is completely dissolved in the melt, the melt is held for 10 min, followed by continuous casting by means of a carbon mold to produce a wire rod having a diameter of 0.08 mm. The wire rod is drawn to a diameter of 0.02 mm. Thus, an ultrafine copper alloy wire is produced.

According to the first preferred embodiment described above, since the inner conductor 1 and the outer conductor 3 are formed of an ultrafine copper alloy wire in which the inclusion of foreign materials, causative of wire breaking, in the base material has been minimized, wire breaking is less likely to occur in the step of wire drawing. This contributes to improved productivity, and can provide extrafine coaxial cables possessing excellent bending properties.

Fig. 2 shows an extrafine coaxial cable according to the second preferred embodiment of the invention. The construction of the extrafine coaxial cable shown in Fig. 2 is the same as that of the extrafine coaxial cable according to the first preferred embodiment, except that the inner conductor 1 is constituted by a single-wire conductor formed of an ultrafine copper alloy with a diameter of 0.06 mm which has been produced in the same manner as described above in connection with the first preferred embodiment. The extrafine coaxial cable according to this second preferred embodiment is inferior to that according to the first preferred embodiment in bending properties. However, as with extrafine the coaxial cable according to the first preferred embodiment, in the extrafine coaxial cable according to the second preferred embodiment of the invention, wire breaking is less likely to occur in the step of wire drawing. Therefore, the productivity can be improved.

EXAMPLES

<Examples 1 and 2>

Ultrafine copper alloy wires of Examples 1 and 2 according to the invention were produced as follows. High-purity copper (purity of copper: 99.9999% by mass) as a base material was pickled to remove foreign materials adhered onto the surface of the copper, was set within a carbon crucible, and was vacuum melted in a small continuous casting system. After copper was completely melted, the atmosphere in the chamber was replaced by argon gas. 2% by mass (Example 1) or 5% by mass (Example 2) of silver (purity: 99.99% by mass) was then added to the melt. After silver was completely dissolved in copper, the melt was held for 10 min, followed by continuous casting by means of a carbon mold to produce a wire rod with a diameter of 8.0 mm which was then drawn to a diameter of 0.02 mm.

<Examples 3 to 6>

Ultrafine copper alloy wires of Examples 3 to 6 according to the invention were produced as follows. High-purity copper (purity of copper: 99.9999% by mass) as a base material was pickled to remove foreign materials adhered onto the surface of the copper, was set within a carbon crucible, and was vacuum melted in a small continuous casting system. After copper was completely melted, the atmosphere in the chamber was replaced by argon gas. 2% by mass (Examples 3 and 4) or 5% by mass (Examples 5 and 6) of silver (purity: 99.99% by mass) was then added to the melt. After silver was completely dissolved in copper, the melt was held for 10 min. 0.05% by mass (Examples 3 and 5) or 0.2% by mass (Examples 4 and 6) of magnesium (purity: 99.9% by mass) was then added to the melt, and the

melt was held for additional 10 min. Continuous casting was then carried out by means of a carbon mold to produce a wire rod with a diameter of 8.0 mm which was then drawn to a diameter of 0.02 mm.

<Examples 7 to 10>

Ultrafine copper alloy wires of Examples 7 to 10 according to the invention were produced as follows. High-purity copper (purity of copper: 99.9999 % by mass) as a base material was pickled to remove foreign materials adhered onto the surface of the copper, was set within a carbon crucible, and was vacuum melted in a small continuous casting system. After copper was completely melted, the atmosphere in the chamber was replaced by argon gas. 2% by mass (Examples 7 and 8) or 5% by mass (Examples 9 and 10) of silver (purity: 99.99% by mass) was then added to the melt. After silver was completely dissolved in copper, the melt was held for 10 min. 0.01% by mass (Examples 7 and 9) or 0.1% by mass (Examples 8 and 10) of indium (purity: 99.99% by mass) was then added to the melt, and the melt was held for additional 10 min. Continuous casting was then carried out by means of a carbon mold to produce a wire rod with a diameter of 8.0 mm which was then drawn to a diameter of 0.02 mm.

<Comparative Example 1>

An ultrafine copper alloy wire of Comparative Example 1 was produced as follows. Oxygen-free copper (purity of copper: 99.99% by mass) was melted in a crucible made of SiC or the like in the air. 0.3% by mass of tin (purity: 99.9% by mass) was then added to the melt, and the melt was held for 10 min,

followed by continuous casting and rolling to produce a wire rod with a diameter of 11.0 mm which was then drawn to a diameter of 0.02 mm.

<Comparative Examples 2 and 3>

Ultrafine copper alloy wires of Comparative Examples 2 and 3 were produced as follows. Oxygen-free copper (purity of copper: 99.99% by mass) was melted in a crucible made of SiC or the like in the air. 2% by mass (Comparative Example 2) or 5% by mass (Comparative Example 3) of silver (purity: 99.99% by mass) was added to the melt, and the melt was held for 10 min, followed by continuous casting and rolling to produce a wire rod with a diameter of 11.0 mm which was then drawn to a diameter of 0.02 mm.

<Comparative Examples 4 to 7>

Ultrafine copper alloy wires of Comparative Examples 4 to 7 were produced as follows. Oxygen-free copper (purity of copper: 99.99% by mass) was melted in a crucible made of SiC or the like in the air. 2% by mass (Comparative Examples 4 and 5) or 5% by mass (Comparative Examples 6 and 7) of silver (purity: 99.99% by mass) was added to the melt, and the melt was held for 10 min. 0.05% by mass (Comparative Examples 4 and 6) or 0.2% by mass (Comparative Examples 5 and 7) of magnesium (purity: 99.9% by mass) was then added to the melt, and the melt was held for additional 10 min, followed by continuous casting and rolling to produce a wire rod. During the drawing of the wire rod, wire breaking attributable to the inclusion of the material constituting the crucible frequently occurred. Therefore, the experiment was ceased.

<Comparative Examples 8 to 11>

Ultrafine copper alloy wires of Comparative Examples 8 to 11 were produced as follows. Oxygen-free copper (purity of copper: 99.99% by mass) was melted in a crucible made of SiC or the like in the air. 2% by mass (Comparative Examples 8 and 9) or 5% by mass (Comparative Examples 10 and 11) of silver (purity: 99.99% by mass) was added to the melt, and the melt was held for 10 min. 0.01% by mass (Comparative Examples 8 and 10) or 0.1% by mass (Comparative Examples 9 and 11) of indium (purity: 99.99% by mass) was then added to the melt, and the melt was held for additional 10 min, followed by continuous casting and rolling. In this case, the surface of the resultant wire rod was deeply cracked. Therefore, the wire rod was judged to be improper as the base material of the ultrafine wire, and the experiment was ceased.

The ultrafine copper alloy wires prepared above were measured for tensile strength (MPa) in the case of drawing to a diameter of 0.02 mm, electrical conductivity (% IACS), and the amount of drawn wire per breaking (kg/break) when 20 kg of the wire was drawn.

The results of measurement are shown in Table 1.

Table 1

Sample	Ag content, mass%	Mg content, mass%	In content, mass%	Sn content, mass%	Impurity content, ppm	Tensile strength, mP	Electrical conductivity, %IACS	Amount of drawn wire, kg/break
Ex. 1	2.0	-	-	-	< 1	1,030	81	2.22
Ex. 2	5.0	-	-	-	< 1	1,220	70	2.50
Ex. 3	2.0	0.05	-	-	< 1	1,060	78	2.50
Ex. 4	2.0	0.2	-	-	< 1	1,090	76	2.50
Ex. 5	5.0	0.05	-	-	< 1	1,250	66	2.22
Ex. 6	5.0	0.2	-	-	< 1	1,280	64	2.00
Ex. 7	2.0	-	0.01	-	< 1	1,050	79	2.50
Ex. 8	2.0	-	0.1	-	< 1	1,105	78	2.00
Ex. 9	5.0	-	0.01	-	< 1	1,255	68	2.22
Ex. 10	5.0	-	0.1	-	< 1	1,290	67	2.00
Comp.Ex. 1	-	-	-	0.3	17	830	73	1.11
Comp.Ex. 2	2.0	-	-	-	16	1,050	81	1.18
Comp.Ex. 3	5.0	-	-	-	17	1,250	70	1.25

Comp.Ex. 4	2.0	0.05	-	-	15	-	-	-
Comp.Ex. 5	2.0	0.2	-	-	17	-	-	-
Comp.Ex. 6	5.0	0.05	-	-	16	-	-	-
Comp.Ex. 7	5.0	0.2	-	-	15	-	-	-
Comp.Ex. 8	2.0	-	0.01	-	18	-	-	-
Comp.Ex. 9	2.0	-	0.1	-	17	-	-	-
Comp.Ex. 10	5.0	-	0.01	-	16	-	-	-
Comp.Ex. 11	5.0	-	0.1	-	16	-	-	-

Further, ultrafine copper alloy wires prepared in Examples 1 to 4 and Comparative Example 5 were used to prepare samples having structures shown in Figs. 1 and 2. A load of 100 gf was applied to each sample, and a left-and-right 90-degree bending test was carried out under conditions of bending r = 1 mm and rate 30 cycles/min.

The test results are shown in Table 2.

Table 2

Sample	Ag content, mass%	Mg content, mass%	In content, mass%	Sn content, mass%	Impurity content, ppm	Bending fatigue lifetime, cycle	
						Fig. 1	Fig. 2
Ex. 1	2.0	-	-	-	< 1	1,950	380
Ex. 2	5.0	-	-	-	< 1	2,300	440
Ex. 3	2.0	0.05	-	-	< 1	2,130	410
Ex. 4	2.0	0.2	-	-	< 1	2,210	425
Comp. Ex. 5	-	-	-	0.3	17	1,300	250

As is apparent from Table 1, for the ultrafine copper alloy wires of the examples according to the invention, the amount of drawn wire was improved by approximately twice over that in the comparative ultrafine copper alloy wires. This indicates that the productivity of ultrafine copper alloy wires with a diameter of 0.02 mm has been improved by approximately twice over the productivity of conventional ultrafine copper alloy wires. Further, a not less than 20% improvement in tensile strength could be realized over the conventional copper - 0.3 mass% tin. This could realize materials which are less likely to cause wire breaking attributable to ductile fracture and, at the same time, have electrical conductivity comparable to or better than the conventional materials.

Further, as is apparent from Table 2, the bending fatigue lifetime of the extrafine coaxial cables using the ultrafine copper alloy wires of the examples according to the invention was 50% or more better than the conventional extrafine coaxial cables using copper - 0.3 mass% tin.

The conductor may be one produced by heat treating the conductor formed of one of the ultrafine copper alloy wires prepared in the examples of the invention to regulate the elongation to not less than 5%.

The conductor may be one produced by adding a very small amount of magnesium or indium to a fiber-reinforced metal composed of chromium, iron, niobium or the like added to high-purity copper (99.9999% by mass) and then conducting wire drawing to a size level of ultrafine wires.

As described above, according to the invention, since the

inclusion of foreign materials, causative of wire breaking, in the base material has been minimized, excellent wire drawability and bending properties can be realized. Further, by virtue of the use of silver as an additive element, the tensile strength is excellent.

The invention has been described in detail with particular reference to preferred embodiments, but it will be understood that variations and modifications can be effected within the scope of the invention as set forth in the appended claims.